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FAME Mission PDR Review Board

Summary Report

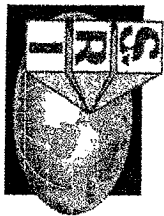
prepared by

Josef Wonsever, NASA GSFC

Bill Gibson, SwRI

11/28/01

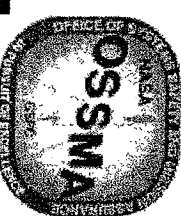
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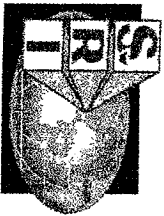
Review Process Summary

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- ◆ The FAME MIDEX Mission PDR was held at the Naval Research Laboratory on 30 and 31 October 2001
- ◆ Review purpose was to evaluate the technical status and readiness of FAME to be confirmed to proceed into Phase C
 - Programmatic were considered, but were not the main focus
- ◆ Integrated Independent GSFC/External review team:
 - Internal GSFC review team led by Joe Wonsever
 - External review team led by Bill Gibson of Southwest Research Institute
- ◆ The integrated review team developed the findings and recommendations contained in this presentation
- ◆ A separate Independent Confirmation Assessment Board, chaired by Mr. Vernon Meyers, participated in the PDR and conducted an additional review of the mission's readiness to proceed into Phase C from a programmatic perspective
 - PDR Co-Chairs also participated in the Confirmation Assessment Review



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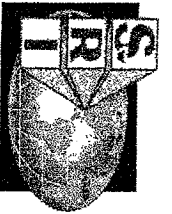
Review Results Overview

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- ◆ A total of 36 RFAs were generated
 - 11 relating to instrument/science issues
 - 7 relating to spacecraft issues
 - 9 relating to integration and test and system engineering issues
 - 6 relating to programmatic issues
 - 3 relating to mission operations issues
- ◆ Risks were categorized and ranked by the PDR board
 - Risks were identified as being technical, cost or schedule
 - Risks were ranked on a subjective scale ranging from 1 to 5 with a risk ranking of 1 being the lowest
 - Risks were summarized and documented in a draft report for use by the GSFC FAME Project Manager and PDR Board members



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Risk Summary

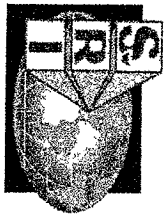
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Risk Category	Risk Rank	Total # Risk Elements
Technical	5	4
	4	2
	3	6
	2	2
	1	0
Schedule	5	0
	4	2
	3	2
	2	1
	1	1
Cost	5	0
	4	0
	3	0
	2	2
	1	2
Notes:	Risks are ranked from a highest ranking of 5 to a lowest ranking of 1. The basis for the ranking is the judgment of the review board members.	

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Highest Risk Items

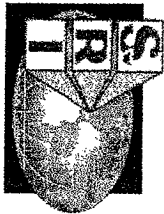
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Risk Category	Element	Mag. (1-5)	Mitigation	Final Mag	Resources To Mitigate	Comments/ Suggestions
Technical	Detector Delivery	5	Existing part with proven manufacturing yield and history is needed promptly	2	1 man week to review contracting alternatives	Established yield is essential since many devices are needed quickly if FAME is to stay on schedule.
	Detector Radiation Life	5	Testing, shielding	2	3-4 man months of effort (best case) to implement a radiation test effort assuring SiTe and Marconi CCDs can be made available for testing.	It seems imperative that a radiation resistance test be run on a SiTe and Marconi CCD ASAP to determine if there is a realistic chance of the SiTe CCDs withstanding the radiation environment.
	Custom CCD	5	Investigate use of an off-the-shelf CCD	2	2-3 man months to investigate alternatives. Resources to replace custom SiTe CCD with a different part could be high, 2-3 many years	If a proven CCD could be adopted in place of the custom SiTe device, the uncertainties in the FAME schedule could be replaced.
	S/C Stability	5	Stability requirements within the realm of S/C design?	1	3-4 man months of analysis and simulation	As a continuation of the risk listed above, the S/C stability figures directly into the quality of the observation.
	Optical Centroiding Accuracy	4	Determine the effects of asymmetric PSF on centroid accuracy	2	Unknown	This seems to be a fundamental issue with the quality of the observation and the ability to meet mission success criteria.
	Apparent Lack of Communications between NRL and LMMS	4	Add NRL staff member on-site at LMMS?	3	Approx 1 man year	On-site support could greatly improve communications on system resources, interfaces, operations, and particularly s/c computer software requirements

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Risk Mitigation/ Recommendation 1

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◆ ISSUE: CCD Availability

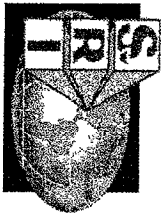
- Detector delivery schedule has slipped significantly since inception owing to developmental problems and other non-technical issues
- The mission currently has no backup to the SITe CCDs; a late delivery of the CCDs will cause a day for day slip in the critical path of the mission
- Yield from SITe of CCDs with acceptable performance is unclear owing to differences in performance of the early models of the CCDs.

◆ RECOMMENDATION:

- Complete a thorough review of the availability of CCDs from other vendors, make every effort to adapt the focal plane design to accept a standard CCD with established radiation characteristics.

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Risk Mitigation/ Recommendation 2

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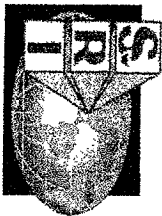


◆ ISSUE: CCD Radiation Hardness

- The radiation resistance of the SITe CCDs is unknown but is critical to mission success
- Owing to the developmental problems with the custom CCDs being developed for FAME, it is very difficult to estimate the resistance of the CCDs to ionizing radiation

◆ RECOMMENDATION:

- It is imperative that a radiation characterization test sequence be run on the production version of the SITe CCDs.
- At the same time it is highly recommended that a radiation test be conducted on one or more of the Marconi CCDs that could be adapted for use on FAME.



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Risk Mitigation/ Recommendation 3

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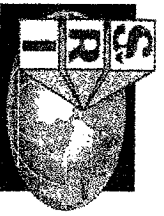


◆ ISSUE: CCD Reliability

- The CCDs planned for use on FAME are custom devices using manufacturing processes that a new to the CCD foundry
- In addition to concerns about the ability of the devices to withstand ionizing radiation, there are also concerns about the long term life expectancy of these detectors

◆ RECOMMENDATION:

- Conduct a design/trade study to evaluate the use of fully developed CCDs from Marconi or other suppliers to determine the performance compromises and the design modifications required of the focal plane assembly to use standard, off-the-shelf CCDs



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Risk Mitigation/ Recommendation 4

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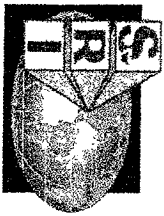


◆ ISSUE: Spacecraft Jitter

- Owing to the extremely high stability requirements needed to meet the mission's fundamental science measurement requirement of 50 micro arc seconds, even the slightest jitter could compromise the core mission
- During the PDR the spacecraft ACS team stated that the system was too complex to model and analyze regarding jitter. This leaves open the question of whether the mission's most important measurement can be made

◆ RECOMMENDATION:

- Accept help from GSFC or other institutions to develop the analytical model necessary to gain confidence that the spacecraft jitter will not prove to be a fatal flaw in the mission design

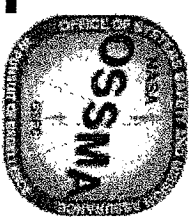


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Risk Mitigation/ Recommendation 5

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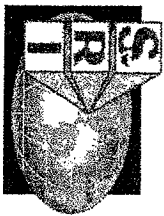


◆ ISSUE: Spacecraft Redesign

- Multiple spacecraft systems were in a state of change at the time of the mission PDR
- Propulsion system is in transition to a different configuration that was presented
- Spacecraft structure was in the process of being updated to accommodate the modified propulsion system
- Solar array was also in the process of being updated to accommodate an increase in instrument power consumption

◆ RECOMMENDATION:

- Complete redesign and associated analyses
- Hold a Δ PDR to review the major system design changes (propulsion, structural, power, etc.)



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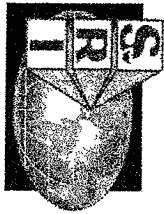
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Conclusions

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- ◆ The FAME mission is very ambitious both from a science and a technology perspective
- ◆ The NRL and LMMS team are both highly experienced and have strong institutional capabilities
- ◆ Some technical risk issues identified during the PDR are serious enough that they should be retired or at least significantly reduced before proceeding into Phase C
- ◆ Schedule realism is highly dependent on resolving current technical issues
- ◆ Cost control, especially on the instrument, has been a very serious problem throughout Phase B
 - Current funding is insufficient, but PI may raise additional funds
- ◆ Because of the scientific potential of the mission and the good progress made in many areas of the project, the PDR Board does not recommend termination of the mission at this time



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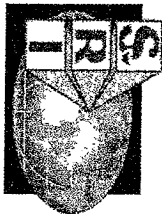


◆ RFA Listing

- 1 – Document Status List needed
- 2 – Science performance descscope analysis (vs minimum science)
- 3 – Risk management process improvements
- 4 – Define top-level data loss requirement (spacecraft and ground system)
- 5 – EMI compatibility verification (RF effects on FPA/CCD noise)
- 6 – Maximum heater power vs peak power limits
- 7 – Simplification of instrument operating states
- 8 – CPU utilization and memory usage margins and tracking
- 9 – Heater power for FPA decontamination
- 10 – CCD flatness/peeling concerns (RTV use with large ΔT)
- 11 – Resolution of basic angle change spec violation
- 12 – Test plan improvements
- 13 – Peer review information (action items generated, status)
- 14 – CCD trade study information
- 15 – Need for integrated NRL/LMMS risk management process
- 16 – Instrument level vibration test plans
- 17 – Trade study for eclipse season observing requirements
- 18 – EMI compatibility testing for star-tracker and science payload

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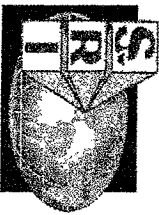


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◆ RFA Listing (continued)

- 19 – Propulsion system peer review for major redesign
- 20 – Redundant windings for motors
- 21 – Redundant fuses and pre-launch fuse verification
- 22 – Thermal analysis for open-circuited solar cells
- 23 – Spacecraft and instrument safehold and fault protection
- 24 – Observatory sine testing for Delta environment
- 25 – Reserved (*duplicate concern – RFAs combined*)
- 26 – ITO coating contamination issues
- 27 – Instrument venting strategy (possible launch over-pressure)
- 28 – Software development plan (timeliness and content)
- 29 – Instrument and spacecraft contamination analyses
- 30 – FPA thermal control design lacks maturity
- 31 – Thermal model validity checks (thermal modeling software quirks)
- 32 – Observatory/Instrument thermal balance test plans
- 33 – Launch vehicle fairing dynamic clearance analysis
- 34 – Definition of MOC vs SOC operator responsibilities
- 35 – Operations staffing analysis (for anomaly responses)
- 36 – Affect of low data rate period on astrometry measurement accuracy



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◆ Review Board Membership:

■ Josef Wonsever	GSFC/Review Co-Chairman
■ William Gibson	SWRI/Review Co-Chairman
■ David Ward	GSFC/GN&C
■ Alphonso Stewart	GSFC/Mechanical Systems
■ George Daelemans	GSFC/Thermal
■ Phillip Chen	GSFC/Contamination Control
■ Richard Burley	GSFC/Ground Systems
■ Steven Battel*	Battel Eng/Electrical Systems
■ Ronnie Killough	SWRI/Software
■ David Kusnierkiewicz	APL/Spacecraft Systems
■ Michael Lampton	UCB/Detectors
■ David Slater	SWRI/Optics

*Did not attend meetings, but reviewed presentation and backup materials

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